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(54) Title: HEAT REFLECTIVE COATED STRUCTURAL ARTICLE

(57) Abstract: The present invention relates to a heat reflective coated structural article comprising a heat reflective component and a coated structural article component which comprises a substrate having an ionic charge coated with a coating having essentially the same ionic charge. The coating of the coated structural article consists essentially of a filler material and a binder material wherein the binder material bonds the filler material together and to the substrate and wherein the coating does not bleed through the substrate. Nonlimiting examples of the heat reflective component include, elastomeric coatings, aluminum fiber coatings, acrylic and polyurethane coating systems, ceramic coatings insulating paints, metal pigment paints, metal pigment pastes and aluminum flakes. The heat reflective coated structural article of the present invention may be incorporated into commercial roofing products.

**HEAT REFLECTIVE COATED STRUCTURAL ARTICLE****SPECIFICATION****FIELD OF THE INVENTION**

This invention relates to a heat reflective coated structural article  
5 useful in, for example, commercial roofing applications comprising a heat reflective component and a coated structural article component which comprises a substrate having an ionic charge coated with a coating having essentially the same ionic charge. The heat reflective coated structural article of the present invention is useful for reducing cooling costs when used as a final layer of a roofing system, particularly a  
10 commercial roofing system.

**BACKGROUND OF THE INVENTION**

Conventional roofing for commercial and industrial buildings usually consists of a roof deck covered by a layer of insulation followed by a water proof membrane and an exterior surface. Many commercial buildings have flat roofs upon  
15 which a commercial roofer commonly applies roll roofing in large single sheets. Asphalt is generally applied to the surface of the roof and the roll roofing is then applied on top of the asphalt. Alternatively, the roll roofing may have a layer of asphalt on one surface which is heated to apply the roll roofing to the roof.

There are many problems involving undesirable heat transfer  
20 associated with conventional commercial roofing because the roof absorbs solar energy from the sun. As a result, the roof becomes very hot during the day, causing higher interior temperatures and resulting in higher cooling costs. Typical roofing materials such as mineral cap sheets, modified bitumen, asphalt, and gravel can absorb more than 70 percent of the solar energy that falls on them. Roofs having dark  
25 roofing materials, which tend to absorb more of the sun's solar energy, may become as hot as 88° C (190° F) on a sunny day. Even lighter colored roofing materials (e.g. white or green) can become as hot as 79° C (175° F).

Certain insulation materials and constructions have been disclosed in the past to reduce cooling costs, including using a liquid medium located on a building structure which can be cooled, such as a water jacketed enclosure. *See* U.S. Patent Nos. 3,450,192 and 3,563,305 of Hay. U.S. Patent Nos. 3,994,278 and 5 4,082,080 of Pittenger disclose heating and cooling systems which utilize an energy source and a fluid body as a storage medium. The fluid body is distributed over the roof of a building and includes mechanisms for regulating the temperature within the enclosed structure. In these types of systems, optimum cooling efficiency cannot be obtained and an external source is needed to obtain the cooling, which results in 10 additional costs.

Other methods for reducing cooling costs comprise applying a reflective coating onto the roof after the roof has been installed (retrofitted coatings) which reduce the amount of solar energy that is absorbed by the roof. Reflective coatings can reflect much of the sun's heat rays and can lead to reduced interior 15 building temperatures and reduced cooling costs. For example, white roof coatings can reflect 70% to 80% of the sun's energy. Reflective coatings may include, *inter alia*, elastomeric coatings, aluminum fiber coatings, acrylic and polyurethane coating systems such as Mule-Hide acrylic and polyurethane coating systems available from Better Roofing Mid Atlantic, Inc. (Jacksonville, North Carolina), ceramic coatings, 20 insulating paints such as those disclosed in U.S. Patent 4,623,390 of Delmonico, metal pigment paints, and metal pigment pastes such as those disclosed in U.S. Patent No. 5,993,523 of Keemer et al. By making the roof less absorptive of the sun's heat rays, significant cooling-energy savings can be achieved. In addition, lighter colored roofs tend to last longer. *See* <<http://www.energy-seal.com>> visited May 12, 2000.

25 The Environmental Protection Agency (EPA) and the Department of Energy (DOE) have organized the Energy Star® Roof Products Program which is aimed at reducing cooling costs by using cool roofing products. *See* <<http://www.energy-seal.com>> visited May 12, 2000. The EPA and the DOE have recognized the energy-saving cost benefits of using reflective coatings on roofs and 30 are advocating their use. The Energy Star® label can be used on reflective roof products that meet the EPA's specifications for solar reflectance and reliability to help

consumers identify energy-efficient products. For example, the Energy Star® label may be used on roof products for low-slope roofs (surfaces with a slope of 2:12 inches or less) that have an initial solar reflectance greater than or equal to 0.65 and that have a solar reflectance greater than or equal to 0.5 three years after installation under 5 normal conditions. As another example, the Energy Star® label may be used on roof products for steep-slope roofs (surfaces with a slope greater than 2:12 inches) that have an initial solar reflectance greater than or equal to 0.25 and that have a solar reflectance greater than or equal to 0.15 three years after installation under normal conditions.

10 The solar reflectance of roofing products can vary dramatically. For example, the solar reflectance of commercial asphalt shingles is rather low. Premium white shingles have a solar reflectance of around 30%, and other colors reflect less. See <<http://eetd.lbl.gov/coolroof/asshingl.htm>> visited October 27, 2000. The solar reflectance of smooth bitumen roofing membrane is around 6%.  
15 <<http://EandELBL.gov/coolroof/membrane.htm>> visited October 27, 2000. The solar reflectance of new, bare galvanized steel is 61%. See <<http://EandELBL.gov/CoolRoof/metal.htm#metal>> visited October 27, 2000.

20 While the cost benefits of reflective coated cool roofing are documented, the cost of installing cool roofing is also an issue. Conventional commercial roll roofing is often coarse and can absorb coating that is applied to it. Such coarse roofing products require the use of significant amounts of reflective coating, which can be costly. Furthermore, conventional commercial roofing generally uses other components such as heavy glass mats, granules and finishes which add to the material and installation costs. Furthermore, conventional 25 commercial roofs require that the coating be applied after the roof is installed, which also increases installation costs.

30 Thus, there is a need for an easier, more cost efficient means to apply an energy-efficient reflective surface to commercial roofs. In particular, there is a need for pre-manufactured commercial roofing material which comprises a reflective coating on its surface and is less costly to manufacture and install than conventional commercial roofing materials.

### SUMMARY OF THE INVENTION

The present invention provides a heat reflective coated structural article comprising a heat reflective component and a coated structural article component which comprises a substrate having an ionic charge coated with a coating having essentially the same ionic charge. The coating of the coated structural article component consists essentially of a filler material and a binder material wherein the binder material bonds the filler material together and to the substrate and wherein the coating does not bleed through the substrate. The heat reflective component may be selected from the following nonlimiting examples: elastomeric coatings, aluminum fiber coatings, acrylic and polyurethane coating systems such as Mule-Hide acrylic and polyurethane coating systems available from Better Roofing Mid Atlantic Inc. (Jacksonville, North Carolina), ceramic coatings, insulating paints, metal pigment pastes, metal pigment paints, coloring dyes, colored coatings, and aluminum flakes.

The heat reflective coated structural article of the present invention can be incorporated into conventional commercial roofing materials to achieve energy-efficient cool roofing materials. Furthermore, the heat reflective coated structural article of the present invention eliminates the need for other products, such as glass mats, granules and other finishes typically used in commercial roofing materials, thus reducing the costs of manufacturing and installing the roofing materials. The commercial roofing materials which incorporate the heat reflective coated structural articles of the present invention are easier to handle than conventional commercial roofing materials and may be lighter in weight than other commercial roofing materials. In addition, they eliminate the need for post-installation application of the heat reflective component and they reduce the amount of heat reflective component necessary, both of which reduce the cost of the roofing material.

### DETAILED DESCRIPTION

The applicants have discovered that a cost-efficient heat reflective coated structural article for use in commercial roofing materials can be made by combining a heat reflective component with a coated structural article component.

The coated structural article component comprises a substrate having an ionic charge coated with a coating having essentially the same ionic charge. The coating of the coated structural article component consists essentially of a filler material and a binder material. For example, United States Patent No. 5,965,257, which is 5 incorporated herein by reference, teaches that by coating the substrate with a coating having essentially the same ionic charge, a zero bleed through product is made while using only two major ingredients in the coating. By producing a coating having essentially the same ionic charge as the substrate, a zero bleed through product may be produced having a low binder content and no viscosity modifiers.

10 The coated substrate of the coated structural article component may be any suitable reinforcement material capable of withstanding high temperatures such as glass fibers, polyester fibers, cellulosic fibers, asbestos, steel fibers, alumina fibers, ceramic fibers, nylon fibers, graphite fibers, wool fibers, boron fibers, carbon fibers, jute fibers, polyolefin fibers, polystyrene fibers, acrylic fibers, phenol-formaldehyde 15 resin fibers, aromatic and aliphatic polyamide fibers, polyacrylamide fibers, or mixtures thereof which may include bicomponent or multicomponent fibers.

16 The filler employed in the coating of the coated structural article component may be class F fly ash, class C fly ash or mixtures thereof. Preferably, the 20 filler is class F fly ash wherein 90% to 95% by weight of the fly ash is aluminosilicate. Such a fly ash, known as Alsil O4TR, is produced by ISG Industries, of Kennesaw, Georgia. Alternatively, the filler may be charged calcium carbonate or ceramic microspheres, or a blend of fly ash and calcium carbonate, or a blend of fly ash, calcium carbonate, ceramic microspheres and dolomite.

25 The table below provides, in percentages, some of the combinations of calcium carbonate, fly ash and ceramic microspheres which may be utilized as the filler component in the coating:

TABLE I

	A	B	C	D	E	F
	%	%	%	%	%	%
1. Water	18.9	25.9	37.33	25.9	24.9	24.9
5 2. Acrylic Latex	6.0	6.0	6.42	6.0	6.0	6.0
3. Fly Ash	75.0	34.0	-----	40.0	-----	20.0
4. CaCO <sub>3</sub>	-----	34.0	-----	-----	40.0	20.0
5. Microspheres	-----	-----	56.14	28.0	29.0	29.0
6. Defoamer	0.1	0.1	0.1	0.1	0.1	0.1
10	<u>100%</u>	<u>100%</u>	<u>100%</u>	<u>100%</u>	<u>100%</u>	<u>100%</u>

The microspheres may be a 50/50 ratio of 3M's W1012 microspheres and 3M's smaller diameter G200 microspheres. Although the table shows possible combinations of calcium carbonate, fly ash and ceramic microspheres in the filler component of the coating, it is believed that any combination of these materials may be employed.

15 The coating of the coated structural article component is prepared by using a binder material such as a high performance heat-reactive acrylic latex polymer to bond the filler materials together and to bond the filler to the substrate. Such a binder material is Hycar 2679 acrylic latex polymer supplied by B.F. Goodrich Company of Cleveland, Ohio. It is believed, however, that any linear polymer, linear 20 copolymer or branched polymer may be useful in preparing the coating. Possible binder materials include butyl rubber latex, SBR latex, neoprene latex, polyvinyl alcohol emulsion, SBS latex, water based polyurethane emulsions and elastomers, vinyl chloride copolymers, nitrile rubbers and polyvinyl acetate copolymers.

In a preferred embodiment, the coating of the coated structural article 25 component may comprise nearly 85% by weight of the structural article. In that coating, approximately from 84% to 96% by weight may be filler and the remainder may be the acrylic latex binder. The filler may be approximately 50% fly ash and 50% calcium carbonate. The substrate may comprise about 15% by weight of the structural article. Glass fibers may comprise approximately 12% by weight of the article and a 30 binder material may comprise about 3% by weight of the article. The binder which

bonds together the glass fibers may be from 99% to 75% (preferably 98% to 94%) by weight urea formaldehyde and from 1% to 25% (preferably 2% to 6%) by weight standard acrylic latex.

The substrate of the coated structural article component may be coated 5 by air spraying, dip coating, knife coating, roll coating or film application such as lamination/heat pressing. The coating may be bonded to the substrate by chemical bonding, mechanical bonding and/or thermal bonding. Mechanical bonding may be achieved by force feeding the coating onto the substrate with a knife.

The coated structural article component made in accordance with this 10 invention may be of any shape but preferably, such articles are planar in shape. The substrate is coated on one side or both sides depending on the intended application.

Additionally, the coated structural article component may be coated with a water repellent material. Examples of such water repellent materials include 15 Aurapel 330R, Aurapel 391 available from the Auralux Corporation of Yantic, Connecticut and Sequapel available from Sequa Chemical Corporation of Chester, South Carolina. It is believed that wax emulsions, oil emulsions, silicone emulsions, polyolefin emulsions, surfonyls and silanes as well as other similar performing products may also be suitable water repellent materials.

Further, structural article components made in accordance with the 20 invention may be coated with an algaecide such as zinc powder, copper oxide powder or the herbicides Atrazine available from e.g. Ribelin Industries or Diuron available from e.g. Olin Corporation, an antifungal material such as Micro-Chek 11P, an antibacterial material such as Micro-Chek 11-S-160, a surface friction agent such as Byk-375, a flame retardant material such as ATH (aluminum trihydrate) available from 25 e.g. Akzo Chemicals and antimony oxide available from e.g. Laurel Industries and/or a coloring dye such as T-1133A and iron oxide red pigments, and other products which can impart specific surface functions. The Micro-Chek products are available from the FerroCorporation of Walton Hills, Ohio. Byk-375 may be obtained from Wacker Silicone Corporation of Adrian, Mich. and T-1133A is sold by Abco Enterprises Inc. 30 of Allegan, Mich.

The additional coatings of, e.g. water repellent material, antifungal material, antibacterial material, etc., may be applied to one or both sides of structural articles otherwise having filler/binder coatings on one or both sides of a substrate. For example, structural articles comprising substrates coated on one or both sides with 5 filler/binder coatings could be coated on one side with a water repellent composition and on the other side with an antibacterial agent.

The substrate may be a nonwoven fiberglass mat which is desirable because it is light in weight. Fiberglass mats are also preferred as substrates because of their fire resistant nature, their resistance to moisture damage, their excellent 10 dimensional stability, their resistance to curl with temperature changes, their resistance to rot and decay, their ability to accept organic coatings and their excellent physical properties.

Nonlimiting examples of heat reflective components include, elastomeric coatings, aluminum fiber roof coatings, ceramic coatings, acrylic and 15 polyurethane coating systems, insulating paints such as those disclosed in U.S. Patent 4,623,390 of Delmonico, metal pigment paints, metal pigment pastes such as those disclosed in U.S. Patent No. 5,993,523 of Keemer et al., coloring dyes, colored coatings, and aluminum flakes.

The heat reflective coated structural article of the present invention has 20 a solar reflectance, as defined by the ASTM Standards of from about 65 to about 100. In a preferred embodiment of the present invention, the heat reflective coated structural article has solar reflectance of from about 70 to about 86. In another embodiment, the heat reflective coated structural article has a visible reflectance of from about 65 to about 100. In another preferred embodiment, the heat reflective coated structural 25 article has a visible reflectance of from about 70 to about 86.

In the present invention, solar reflectance is defined as the fraction of reflected solar energy. One method of determining the solar reflectance involves the use of spectrophotometric measurements with an integrating sphere to determine the reflectance at each different wavelength. The average reflectance is determined by an 30 averaging process using a standard solar spectrum. The spectral range for solar energy is 300 to 2500 nanometers. This method is documented by ASTM (American Society

for Testing and Materials) as standards E903 and E892. In the present invention, the visible reflectance is defined as the reflected fraction of the visual part of the solar spectrum, wavelengths 400 to 700 nanometers. The visible part of the solar spectrum does not include the ultra-violet or infrared portion of the solar spectrum.

5 Preferably, the heat reflective component meets the EPA's requirements and bears the Energy Star® label. EPA compliant heat reflective components include, but are not limited to, Syntec™ and Versico™ (Carlisle Syntec, Inc., Carlisle, PA); CXP Ceco™, CLP Ceco™, MAP Ceco™ and MVR Ceco™ (Ceco Building Systems, Columbus, MI); Hypalon Hy-Crown™, Rapid Roof HV™ and Benchmark™ (Conklin 10 Co., Inc., Shakopee, MN); DSSx1.5 Galvalume™ and DSSx2 Galvalume™ (Delcoa Industries, Inc., Pompano Beach, FL); Dura-Loc™ (Dura-Loc Roofing Systems, Ontario, Canada); Ceramicoat EERS International™ and Total Shield Polyurea EERS International™ (EERS International, Inc.); Eraguard 1000™, Eraguard 500™, Erakote™, Erathane 300™ and Permaweld 48ml™ (Elastomeric Roofing Systems, 15 Loretto, MN); Flex FB Elvaloy™, Flex MF/R Elvaloy™ and Flex MF/R PVC White Membrane (Flex Roofing Systems, Morgantown, PA); 502 RCW Elasto-Kote, 505 Elasto-Brite M, 501 Elasto-Brite, 98AF and 298 Alumin-R (Karnak Corporation, Clark, New Jersey); Acrylic White (Metacrylics, San Jose, California); AcryShield™ A400, AcryShield™ A500, AcryShield™ A550, AcryShield™ A600 (National 20 Coatings Corporation, Camarillo, California); Stevens EP, Stevens Hypalon (CSM) (Stevens Roofing Systems, Holyoke, Massachusetts); Weather Barrier 1650 White, and Weather Barrier 1655 White (Weather Barrier, Inc., Manilla, Philippines).

The heat reflective coating may also be selected from the following nonlimiting examples, Lo/Mit™ (SOLECT™, Ewing, New Jersey), acrylic and 25 polyurethane Mule-Hide roof coating systems (Better Roofing Mid Atlantic, Inc., Jacksonville, North Carolina), Ceramic-Cover (Thermal Protective Systems, L.L.C., Fort Worth, Texas), and aluminum fibered roof coating #726 (Malarkey Roofing Co., Portland, Oregon).

The applicants' invention allows commercial roofing manufacturers to 30 incorporate the heat reflective coated structural article of the present invention into their products to achieve a cost-effective, energy-efficient heat reflective product. In

addition, the incorporation of the heat reflective coated structural article of the present invention into commercial roofing products eliminates the need for post-installation application of a heat reflective coating. The applicant's invention also requires approximately 25% to 50% less reflective component than is necessary to coat

5 conventional commercial roof products. This is because the surface of the coated structural article component is smoother than conventional commercial roofing products, which are coarse and absorb more of the heat reflective component.

Furthermore, other elements of commercial roof products, such as separate glass mats, granules, gravel, asphalt, asphalt emulsions and other finishes are not required, thus

10 making the commercial roofing material which incorporates the heat reflective coated structural article of the present invention lighter, more cost-effective, easier to manufacture and easier to install. Moreover, the applicants' heat reflective coated structural article includes a coated mat which is comprised mainly of nonflammable filler and the mat which is coated by that filled coating is also nonflammable.

15 The heat reflective component of the present invention is applied to one surface of the coated structural article component and may be applied to the coated structural article component by any means known in the art. If the substrate of the coated structural article component has been coated on both sides, then the heat reflective component may be applied to either side. If only one side of the substrate

20 has been coated, then the heat reflective component is preferably applied to the coated side of the coated structural article component. For example, the heat reflective component may be laminated to the coated structural article component (e.g. applied as a film bonded to the coated structural article) or applied with a brush or by a spraying means or a coating means. Where the manufacturer of the heat reflective component

25 has indicated a preferred means of application, such means may be used to apply the heat reflective component to the structural article. The surface of the heat reflective coated structural article of the present invention is the top layer of a commercial roofing material.

The heat reflective coated structural article of the present invention may

30 be used with a variety of commercial roofing materials including, but not limited to, conventional cap sheet, APP modified bitumen sheet, SBS modified bitumen sheet and

built up roofing systems. The heat reflective coated structural article of the present invention may be incorporated into commercial roofing systems, for example, by roll coating a layer of asphalt or modified asphalt to the back of the article; laminating the article to an existing asphalt coated reinforcement as the top layer during 5 manufacturing; post-laminating the article to the top asphalt or modified asphalt layer of an existing roofing membrane using hot asphalt, cold adhesive or heat welding; and installing the article with either hot asphalt or cold adhesive directly as the top layer of a built-up roof.

In one embodiment, the heat reflective coated structural article of the 10 present invention is back coated with an SBS modified bituminous coating to produce a finished cap sheet product which can then be applied directly to a roof using either hot asphalt, heat welding or cold adhesive. Alternatively, a layer of adhesive may be applied to the back of the heat reflective coated structural article to produce a self 15 adhering (peel and stick) product. The product forms the top most layer of the built-up roofing system thereby imparting heat reflectance via the heat reflective coated structural article of the present invention.

In another embodiment, the heat reflective coated structural article of the present invention is applied to a sheet consisting of a glass or polyester mat encased in hot asphalt such that the article is adhered to the top layer of hot asphalt 20 with the reflective surface up. This product can then be applied via heat welding, hot asphalt or cold adhesive over a base sheet as part of a two ply modified bitumen roof.

In a further embodiment, the heat reflective coated structural article of the present invention can be used as the last step in the construction of a built-up roof such that the article is applied to the top layer of hot asphalt in a multi-ply system with 25 the reflective surface of the article facing up on the formed roof surface and imparting heat resistance thereto.

It should be understood that compositions other than those described above can be used while maintaining the principles underlying the present invention. For example, other sources of inert materials as well as mixtures of binders and/or 30 additives can be used in formulating the structural articles. Other suitable types of heat reflective components can be used in combination with the coated substrate to improve

the properties of the heat reflective coated structural articles formed therefrom and the heat reflective coated structural article of the present invention may be utilized together with other suitable roofing products to impart heat reflectance properties to the resultant roof.

5

#### EXAMPLES:

Example 1.

Non-water repellent Versashield™ coated structural articles (Versashield™ coated on both sides, available from Elk Corporation in Ennis, Texas) were coated on one side with one of the following heat reflective materials: 1) ARM-10 91-1, 2) APC-40-1 (both available from Rohm & Haas Co.), and 3) Sherwin Williams White Paint 20 Year. The Solar Reflectivity for each sample was measured by Rohm & Haas Co.'s Coating Technical Service, Springhouse, PA, using a Solar Spectrum Reflectometer, Model SSR-ER, Version 5.0. A single tungsten filament source was used that provided diffuse illumination at the sample port. Energy reflected from the 15 sample was measured at an angle of 20 degrees from normal, with four filtered detectors. The detectors were designated UV, Blue, Red and IR indicating the primary wavelength range each covers. The relative response of each detector in combination with the light source was designed to approximate the solar spectrum in its wavelength range. By summing the four outputs in the appropriate proportions, a solar 20 measurement spectrum was obtained. The percentage of Solar Reflectivity is reported in TABLE II.

TABLE II

Sample ID	Reflectivity (%)	Reflectivity (%) for Those Sample Average
ARM-91-1	85.2	84.8
	85.0	
	84.2	
APC-40-1	84.5	84.3
	84.1	
	84.2	
5 White Sherwin Williams Paint 20 Year	75.0	74.7
	74.5	
	74.5	
Control-VersaShield™	41.3	41.4
	41.5	
	41.5	
10 Lab Coated Sheet with APC-40-1	82.9	83.1
	83.8	
	82.5	
Lab Coated Sheet with ARM-91-1	83	84.0
	84.5	
	83.4	

The present invention is not to be limited in scope by the specific embodiments described herein. Indeed, various modifications of the invention in addition to those described herein will become apparent to those skilled in the art from the foregoing description. Such modifications are intended to fall within the scope of the appended claims. Various references are cited herein, the disclosure of which are incorporated by reference in their entireties.

CLAIMS

1. A heat reflective coated structural article comprising a heat reflective component and a coated structural article component which comprises a substrate having an ionic charge coated with a coating having essentially the same ionic charge wherein said coating consists essentially of a filler material and a binder material and wherein said binder material bonds the filler material together and to the substrate and wherein said coating does not bleed through said substrate.  
5
2. The heat reflective coated structural article according to claim 1 wherein the heat reflective component is selected from the group consisting of elastomeric coatings, aluminum fiber coatings, acrylic coating systems, polyurethane coating systems, ceramic coatings, insulating paints, metal pigment paints, metal pigment pastes, dyes, colored coatings and aluminum flakes.  
10
3. The heat reflective coated structural article according to claim 2 wherein the heat reflective component further comprises a coloring agent selected from the group consisting of coloring dyes and colored coatings.  
15
4. The heat reflective coated structural article according to claim 1 wherein the heat reflective coated structural article has a solar reflectance of from 65% to 100%.
5. The heat reflective coated structural article according to claim 4 wherein the heat reflective coated structural article has a solar reflectance of from 70% to 90%.  
20
6. The heat reflective coated structural article according to claim 1 wherein the heat reflective coated structural article has a solar reflectance of from 74% to 86%.

7. The heat reflective coated structural article according to claim 1 wherein the heat reflective coated structural article has a visible reflectance of from 65% to 100%.

8. The heat reflective coated structural article according to claim 1  
5 wherein the heat reflective coated structural article has a visible reflectance of from 70% to 90%.

9. The heat reflective coated structural article according to claim 1  
wherein the heat reflective coated structural article has a visible reflectance of from 74% to 86%.

10 10. The heat reflective coated structural article according to claim 1  
wherein the heat reflective component is applied to one side of the coated structural article.

11. The heat reflective coated structural article according to claim 1  
wherein said substrate is planar and is coated on one side with said coating and  
15 wherein said heat reflective component is applied to said coating.

12. The heat reflective coated structural article according to claim 1  
wherein said substrate is planar and is coated on both sides with said coating.

13. The heat reflective coated structural article according to claim 1  
wherein the heat reflective component is less than 2 millimeters thick.

20 14. The heat reflective coated structural article according to claim 1  
wherein said article is incorporated as the top layer into a commercial roofing product.

15. The heat reflective coated structural article according to claim 1  
wherein said substrate is fiberglass, said filler is selected from the group consisting of

fly ash, calcium carbonate, ceramic microspheres and mixtures thereof and said binder is acrylic latex.

16. The heat reflective coated structural article according to claim 1  
5 wherein the substrate is selected from the group consisting of glass fibers, polyester fibers, cellulosic fibers, asbestos, steel fibers, alumina fibers, ceramic fibers, nylon fibers, graphite fibers, wool fibers, boron fibers, carbon fibers, jute fibers, polyolefin fibers, polystyrene fibers, acrylic fibers, phenolformaldehyde resin fibers, aromatic and aliphatic polyamide fibers, polyacrylamide fibers, polyacrylimide fibers, and mixtures  
10 thereof.

17. The heat reflective coated structural article according to claim 1  
wherein said heat reflective coated structural article further includes a water repellent material.

18. The heat reflective coated structural article according to claim 1  
15 wherein said heat reflective coated structural article further includes an antifungal material.

19. The heat reflective coated structural article according to claim 1  
wherein said heat reflective coated structural article further includes an antibacterial material.

20. The heat reflective coated structural article according to claim 1  
wherein said heat reflective coated structural article further includes a flame retardant material.

21. The heat reflective coated structural article according to claim 1  
wherein said heat reflective coated structural article further includes a surface friction  
25 agent.

22. The heat reflective coated structural article according to claim 1 wherein said heat reflective coated structural article further includes an algaecide.

23. The heat reflective coated structural article according to claim 1 wherein said substrate is bonded together by a binder material consisting essentially of 5 urea formaldehyde and acrylic latex.

24. The heat reflective coated structural article according to claim 1 wherein the coated structural article component is coated with a coating consisting essentially of a filler material and a binder material and wherein

10 a) said coated structural article component is from 10% to 25% by weight glass fibers; and  
b) said coating is from 84% to 96% filler selected from the group consisting of fly ash, charged calcium carbonate, ceramic microspheres and mixtures thereof and from 16% to 4% acrylic latex binder material.

25. The heat reflective coated structural article according to claim 15 24 wherein said coating further includes SBR rubber.

26. The heat reflective coated structural article according to claim 25 wherein said acrylic latex binder and said rubber are cross linked.

27. The heat reflective coated structural article according to claim 24 wherein said glass fibers are bonded together by a mixture of from 99% to 75% 20 urea formaldehyde and from 1% to 25% acrylic latex.

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(54) Title: HEAT REFLECTIVE COATED STRUCTURAL ARTICLE

(57) Abstract: The present invention relates to a heat reflective coated structural article comprising a heat reflective component and a coated structural article component which comprises a substrate having an ionic charge coated with a coating having essentially the same ionic charge. The coating of the coated structural article consists essentially of a filler material and a binder material wherein the binder material bonds the filler material together and to the substrate and wherein the coating does not bleed through the substrate. Nonlimiting examples of the heat reflective component include, elastomeric coatings, aluminum fiber coatings, acrylic and polyurethane coating systems, ceramic coatings insulating paints, metal pigment paints, metal pigment pastes and aluminum flakes. The heat reflective coated structural article of the present invention may be incorporated into commercial roofing products.

## INTERNATIONAL SEARCH REPORT

International Application No  
PCT/US 01/51209A. CLASSIFICATION OF SUBJECT MATTER  
IPC 7 C03C25/10 E04D5/02 E04D12/00 D04H1/64

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)  
IPC 7 C03C E04D D04H B32B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 965 257 A (AHLUWALIA YOUNGER) 12 October 1999 (1999-10-12) cited in the application the whole document ----	1-27
A	RIEDEL C ET AL: "HEAT-RESISTANT TEXTILE MATERIALS FROM INORGANIC AND/OR INORGANIC AND ORGANIC FIBROUS MATERIALS" CHEMICAL ABSTRACTS + INDEXES, AMERICAN CHEMICAL SOCIETY, COLUMBUS, US, vol. 109, no. 12, 1 September 1988 (1988-09-01), page 286 XP000017992 ISSN: 0009-2258 the whole document ----	16 -/-

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Date of the actual completion of the international search  19 July 2002	Date of mailing of the international search report  29/07/2002
Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel: (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Authorized officer  Reedijk, A

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## INTERNATIONAL SEARCH REPORT

International Application No  
PCT/US 01/51209

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category	Relevant to claim No.	
A	US 5 206 068 A (KALKANOGLU HUSNU) 27 April 1993 (1993-04-27) abstract ---	1-27
A	WO 00 17120 A (HANSEN ERLING LENNART ;CRIDLAND IAN (DK); DYRBOEL SUSANNE (DK); FR) 30 March 2000 (2000-03-30) page 12, line 30 -page 13, line 14 ---	1-21
A	DE 198 24 058 A (BENECKE KALIKO AG) 2 December 1999 (1999-12-02) column 2, line 63 -column 3, line 2; claims ---	1-21
A	EP 0 678 618 A (SARNA PATENT & LIZENZ AG) 25 October 1995 (1995-10-25) claims ---	1-21
A	US 5 001 005 A (BLANPIED ROBERT H) 19 March 1991 (1991-03-19) the whole document -----	1-21

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**INTERNATIONAL SEARCH REPORT**

Information on patent family members

International Application No

PCT/US 01/51209

Patent document cited in search report	Publication date		Patent family member(s)		Publication date
US 5965257	A	12-10-1999	AU	736047 B2	26-07-2001
			AU	7984598 A	19-01-1999
			EP	0991602 A1	12-04-2000
			WO	9900338 A1	07-01-1999
US 5206068	A	27-04-1993	NONE		
WO 0017120	A	30-03-2000	EP	0989103 A1	29-03-2000
			AU	6087499 A	10-04-2000
			AU	6196399 A	10-04-2000
			AU	6196499 A	10-04-2000
			WO	0017120 A1	30-03-2000
			WO	0017121 A1	30-03-2000
			WO	0017123 A1	30-03-2000
			EP	1127032 A1	29-08-2001
			EP	1115674 A1	18-07-2001
			EP	1115671 A1	18-07-2001
DE 19824058	A	02-12-1999	DE	19824058 A1	02-12-1999
			BR	9901671 A	11-01-2000
			US	2001051480 A1	13-12-2001
			ZA	9902426 A	28-06-1999
EP 0678618	A	25-10-1995	CH	686371 A5	15-03-1996
			EP	0678618 A1	25-10-1995
			FI	951851 A	20-10-1995
			NO	951475 A	20-10-1995
US 5001005	A	19-03-1991	US	5112678 A	12-05-1992
			US	5102728 A	07-04-1992

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